

CERES SARB On-line Fu-Liou Radiative Transfer Code Differential 200503 Version

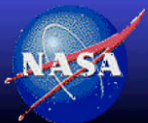
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Ceres Science Team Meeting
Princeton ,NJ May 2-4 2005

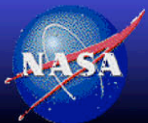


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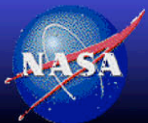
FuLiou Radiative Transfer Model

- Gamma weighted 2-stream (SW) *S.Kato* , 2/4 stream (LW) *Q.Fu*
 - Inhomogeneous clouds in SW
- 29 bands : 15 SW, 14 LW , 3 of 14 LW in WN
- Shortwave: (0.17 - 4.0)um (2500-57000cm⁻¹)
 - Hitran 2000 (H₂O) (O₂,CO₂,CH₄) fixed : H₂O continuum
 - *JPL*(1994) O₃ uv , *WMO*(1985) O₃ vis
- Longwave (0-2850cm⁻¹) (3.5um – infinity)
 - H₂O CO₂ O₃ N₂O CH₄ CFCs
 - H₂O_Continuum(*Kratz&Rose*)
- Cloud Optical Properties Water (*Y.Hu*) Ice (*Q.Fu*)
- Aerosol optical properties
 - *OPAC*, *Tegin&Lacis*, *D'Almedia*, *Lacis(2004)Dust*



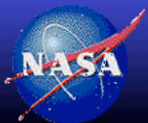
Uses

- Forcing cases
 - Cloud+aerosol (cloud & aerosol – pristine)
 - Cloud (cloud & aerosol – aerosol)
 - Aerosol (cloud & aerosol – cloud)
- Quick sensitivity studies
 - Partial differentials { case B minus case A}
 - Flux or radiance response to various input situations
- Tuning
 - Ceres Sarb constraintment
 - Impose TOA SW , LW, or window flux mismatch
 - Adjustments SkinT,Pw, surface albedo, aerosols, cloud (τ , z)



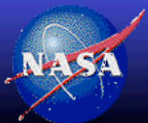
Online Fu Code Options

- Atmosphere options
 - Standard (tropical,MLS,MLW,SAS,saw)
 - Column PW ,O3 changes , skin temperature
 - User input of $p(z)$, $t(z)$, $h_2o(z)$, $o_3(z)$
- Surface Radiative properties
 - Ocean Z. Jin COART surface albedo
 - Ceres SARB IGBP land type spectral albedos and emissivity
- Outputs
 - Table of broadband TOA and SURFACE , SW & LW
 - Vertical flux profiles (coarse 4 levels or fine 120 levels)
 - Spectral SW { TOA albedo , surface transmission,sfc albedo }
 - Spectral LW { TOA flux , surface flux }
 - Longwave anisotropy
 - Detailed but cryptic list of all inputs & outputs



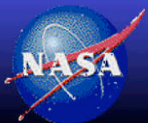
Options (Cont.)

- Clouds
 - Fraction (ICA), optical depth, phase, particle size, top & base
 - Overlapped clouds allowed
 - Inhomogeneity : gamma distribution
 - shape param. $\nu = (\tau/\sigma)^2$
- Aerosols
 - Column optical depth (@0.63 μ)
 - Constituent type determines spectral optical properties
 - Scale height assumption for vertical profile



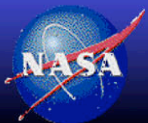
Web Links

- On line Langley Fu-Liou Code
 - <http://www-cave.larc.nasa.gov/rose/flp>
- Ceres
 - <http://asd-www.larc.nasa.gov/ceres/ASDceres.html>
- Cave
 - <http://www-cave.larc.nasa.gov/cave>




No Web Access ?

- The following slides are examples of the actual web site outputs.



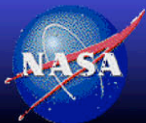
Input Controls

Input Controls			
 Case: <A<B		Forcing <Cloud<Aerosol<Cld+Aer Profile BB Table Output Spec_Toa_AlB	Atmosphere MidLatSummer Atmosphere EDIT <No<Simple<Detail
Cosine Solar Zenith 0.5 Cosine View Zenith 1.0	#Streams <2<GWTSa<4	Surface Albedo IGBP Spectral IGBP 17 Ocean Foam <ON<OFF Wind Speed 5.0 Chlorophyll 0.1	
CO2(ppmv) 360.0 lw only	LW Continuum 2.4_ckd	Surface Elevation (meters) 0.0	Vertical Resolution <LO<HI
Cloud1			
Fraction 1.0	Optical Depth 1.0	Pressure(hPa) Top 250. Bot 300.	Phase <WATER<ICE Size um 60 Inhomgeniety (GWTSa) 100
Cloud2			
Fraction 0.0 Overlap Fraction(1&2) 0.0	Optical Depth 10.0	Pressure(hPa) Top 850. Bot 900.	Phase <WATER<ICE Size um 20 Inhomgeniety (GWTSa) 100
Aerosols			
Optical Depth 1 0.20	Type continental	Scale Hgtkm 4	
Optical Depth 2 0.00	Type 0.5_dust_l2004	Scale Hgtkm 1	
Tune Case A : DOTUNE			

Cloud and Aerosol Forcing Example

- Cloud ($\tau = 1.0$ ice $d_e = 60.$) + Aerosol (Continental $\tau = 0.2$)
- Pristine (no cloud, no aerosol) { only Rayleigh & gases }

CASE {A:Untuned} --> [PRISTINE] <-Vs-> [Cloud+Aerosol]							
Control : [PRISTINE]	SHORTWAVE Flux Wm-2						
Perturbed : [Cloud+Aerosol]	TOA			SURFACE			
Cloud& Aerosol	[PRISTINE]	[Cloud+Aerosol]	Forced	[PRISTINE]	[Cloud+Aerosol]	Forced	
Up	76.6	174.0	97.3	35.3	29.0	-6.3	
Down	682.5	682.5	0.0	485.8	381.0	-104.8	
NET	605.9	508.6	-97.3	450.5	351.9	-98.5	
ALBEDO	0.112	0.255	0.143	0.073	0.076	0.003	
Direct				439.6	158.4	-281.2	
Diffuse				46.2	222.6	176.3	
Direct FulceCor				439.6	45.5	-394.1	
Diffuse FulceCor				46.2	335.5	289.2	
	LONGWAVE Flux Wm-2						
Up	279.7	214.0	-65.6	422.4	422.5	0.1	
Down	0.0	0.0	0.0	350.5	360.5	10.0	
NET	-279.7	-214.0	65.6	-71.8	-62.0	9.8	

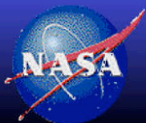


2x CO₂

- Case A: CO₂ = 360 ppmv
- Case B: CO₂ = 720 ppmv

Changes only applied in Longwave

CASE {B minus A} --> [PRISTINE] <-Vs-> [Cloud+Aerosol]							
Controll : [PRISTINE]	SHORTWAVE Flux Wm-2						
Perturbed :[Cloud+Aerosol]	TOA			SURFACE			
Cloud& Aerosol	[PRISTINE]	[Cloud+Aerosol]	Forced	[PRISTINE]	[Cloud+Aerosol]	Forced	
Up	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Down	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NET	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ALBEDO	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Direct				0.0	0.0	0.0	0.0
Diffuse				0.0	0.0	0.0	0.0
Direct FuIceCor				0.0	0.0	0.0	0.0
Diffuse FuIceCor				0.0	0.0	0.0	0.0
	LONGWAVE Flux Wm-2						
Up	-3.1	-1.1	2.0	0.0	0.0	0.0	0.0
Down	0.0	0.0	0.0	1.5	1.2	-0.3	-0.3
NET	3.1	1.1	-2.0	1.4	1.2	-0.3	-0.3



Cloud Properties

CASE {A:Untuned} --> TOA Spectral Albedo (0-100)																
Sw Band um	17:22	22:24	24:28	28:29	29:32	32:35	35:43	43:49	49:59	59:70	70:13	13:19	190:2.5	2.5:3.5	3.5:4.0	BB
[PRISTINE]	1.39	0.34	0.17	0.42	6.76	40.56	32.05	22.81	14.46	10.24	5.81	2.55	2.61	0.26	5.74	11.23
[Cloud+ Aerosol]	1.39	0.34	0.17	0.42	7.24	47.21	43.33	37.10	29.91	27.08	23.51	14.31	11.16	2.01	5.10	25.49
Forcing	0.00	0.00	0.00	0.00	0.48	6.65	11.28	14.29	15.44	16.83	17.70	11.76	8.54	1.75	-0.65	14.26

2x Cloud Optical Depth (Tau:1.0 \diamond 2.0)

CASE {B minus A} --> TOA Spectral Albedo (0-100)																
Sw Band um	17:22	22:24	24:28	28:29	29:32	32:35	35:43	43:49	49:59	59:70	70:13	13:19	190:2.5	2.5:3.5	3.5:4.0	BB
[PRISTINE]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
[Cloud+ Aerosol]	0.00	0.00	0.00	0.00	0.31	3.60	5.51	6.67	7.18	7.98	9.65	6.18	4.00	0.46	-0.43	7.26
Forcing	0.00	0.00	0.00	0.00	0.31	3.60	5.51	6.67	7.18	7.98	9.65	6.18	4.00	0.46	-0.43	7.26

Cloud Particle Size (De: 60 \diamond 30.0)

CASE {B minus A} --> TOA Spectral Albedo (0-100)																
Sw Band um	17:22	22:24	24:28	28:29	29:32	32:35	35:43	43:49	49:59	59:70	70:13	13:19	190:2.5	2.5:3.5	3.5:4.0	BB
[PRISTINE]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
[Cloud+ Aerosol]	0.00	0.00	0.00	0.00	0.03	0.39	0.61	0.75	0.81	0.90	1.24	2.92	3.35	0.67	3.58	1.26
Forcing	0.00	0.00	0.00	0.00	0.03	0.39	0.61	0.75	0.81	0.90	1.24	2.92	3.35	0.67	3.58	1.26

